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NATIONAL EUTROPHICATION SURVEY

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REPORT

ON

LAKE MONROE

SEMINOLE AND VOLUSIA COUNTIES

FLORIDA

EPA REGION IV

WORKING PAPER No. 267

WITH THE COOPERATION OF THE

FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION

AND THE

FLORIDA NATIONAL GUARD

DECEMBER, 1977

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16. ABSTRACT
Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Florida Department of Environmental Regulation for professional involvement and to the Florida National Guard for conducting the tributary sampling phase of the Survey.

Joseph W. Landers, Jr., Secretary of the Department of Environmental Regulation; John A Redmond, former Director of the Division of Planning, Technical Assistance, and Grants; and Dr. Tim S. Stuart, Chief of the Bureau of Water Quality, provided invaluable lake documentation and counsel during the survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

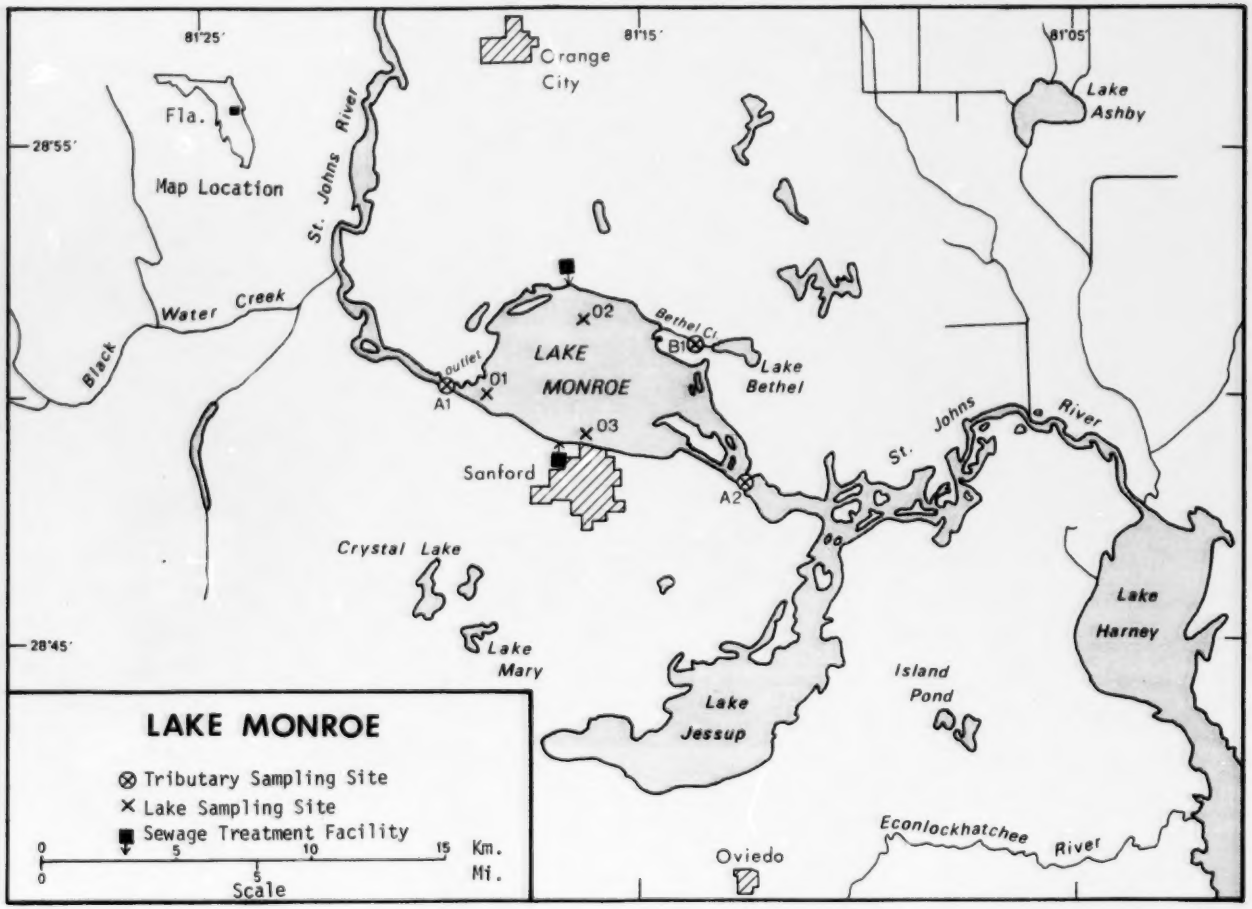
Major General Henry W. McMillan (Retired), then the Adjutant General of Florida, and Project Officer Colonel Hugo F. Windham, who directed the volunteer efforts of the Florida National Guard, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF FLORIDA

LAKE NAME	COUNTY
Alligator	Columbia
Apopka	Lake, Orange
Banana	Polk
Crescent	Flagler, Putnam
Doctors	Clay
Dora	Lake
East Tohopekaliga	Osceola
Effie	Polk
Eloise	Polk
George	Putnam, Volusia
Gibson	Polk
Glenada	Highlands
Griffin	Lake
Haines	Polk
Hancock	Polk
Horseshoe	Seminole
Howell	Orange, Seminole
Istokpoga	Highlands
Jessie	Polk
Jessup	Seminole
Kissimmee	Osceola
Lawne	Orange
Lulu	Polk
Marion	Polk
Minnehaha	Orange
Minneola	Lake
Monroe	Seminole, Volusia
Munson	Leon
Okeechobee	Glades, Hendry, Martin, Okeechobee, Palm Beach
Poinsett	Brevard, Orange, Osceola
Reedy	Polk
Seminole	Jackson, FL; Decatur, Seminole, GA
Seminole	Pinellas
South	Brevard
Talquin	Gadsden, Leon
Tarpon	Pinellas
Thonotosassa	Hillsborough
Tohopekaliga	Osceola
Trout	Lake
Weohyakapka	Polk
Yale	Lake


81°25'
81°15'
81°05'
28°55'
28°45'
Fla.
Map Location
Orange City
Lake Ashby
St. Johns River
Water Creek
Black
LAKE MONROE
Outlet
A1
01
02
03
Bethel Ck.
B1
Lake Bethel
Sanford
A2
St. Johns River
Crystal Lake
Lake Mary
Lake Harney
Island Pond
Lake Jessup
Econlockhatchee River
Oviedo
LAKE MONROE
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
0 5 10 15 Km.
0 5 Mi.
Scale

LAKE MONROE

STORET NO. 1231

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate Lake Monroe is eutrophic. It ranked twenty-ninth in overall trophic quality when the 41 Florida lakes sampled in 1973 were compared using a combination of six parameters*. Twenty-five of the lakes had less median total phosphorus, 27 had less median dissolved phosphorus, 34 had less median inorganic nitrogen, ten had less mean chlorophyll a, and 29 had greater mean Secchi disc transparency.

Survey limnologists observed beds of macrophytes near the shore at sampling station 1 in March and at all three stations in September and November.

Brezonik et al. (in prep.) have reported improved water quality in Lake Monroe during periods of high flow in the St. Johns River. Two of the three Survey lake sampling visits were made during such periods, so data obtained during those visits may not be representative of normal conditions.

B. Rate-Limiting Nutrient:

The algal assay results indicate Lake Monroe was nitrogen limited at the time the sample was collected (11/05/73). The lake data indicate nitrogen limitation at all sampling stations and times.

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* See Appendix A.

C. Nutrient Controllability:

1. Point sources--During the sampling year, Lake Monroe received a total phosphorus loading about nine times that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 13). However, Vollenweider's model probably does not apply to water bodies with short hydraulic retention times, and the mean hydraulic retention time of Lake Monroe is only 10 days.

It is estimated that the wastewater treatment plants considered in this report contributed only about 6% of the total phosphorus and 1.5% of the total nitrogen inputs to the lake during the sampling year; and, regardless of the applicability of Vollenweider's model, elimination of phosphorus from these two plants alone probably would not result in a significant improvement in the trophic condition of the lake.

However, since some of the nutrient loading to the St. Johns River is contributed by sewage treatment plants discharging to the river upstream from Lake Monroe, to Lake Jessup, and to the Econlockhatchee River, advanced waste treatment or effluent diversion at all of these plants might slow the eutrophication of Lake Monro, but a more intensive study of the impact of the distant point sources is needed to determine the effect of overall point-source nutrient control.

2. Non-point sources--The St. Johns River is the primary source of nutrient loading to Lake Monroe and contributed about 91% of the total phosphorus load and 97% of the total nitrogen load to the lake during the sampling year. Much of the nutrient loading to the river results from use of the floodplain as pasture during the annual dry season.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Morphometry††:

1. Surface area: 35.50 kilometers^2.
2. Mean depth: 1.8 meters.
3. Maximum depth: 5.8 meters.
4. Volume: 63.900 x 10^6 m^3.
5. Mean hydraulic retention time: 10 days.

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
St. Johns River	6,397.3	71.12
Bethel Creek	15.5	0.20
Minor tributaries & immediate drainage -	233.9	3.00
Totals	6,646.7	74.32

2. Outlet -

St. Johns River	6,682.2**	74.33

C. Precipitation***:

1. Year of sampling: 125.4 centimeters.
2. Mean annual: 135.5 centimeters.

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† Table of metric conversions--Appendix B.
†† Brezonik et al., (in prep.)
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of lake.
*** See Working Paper No. 175.

III. WATER QUALITY SUMMARY

Lake Monroe was sampled three times in 1973 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from three stations on the lake and from one or more depths at each station (see map, page v). During each visit, a single depth-integrated (near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the third visit, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 2.7 meters at station 1, 1.8 meters at station 2, and 3.4 meters at station 3.

The sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR LAKE MONROE
STORET CODE 1231

PARAMETER	1ST SAMPLING (3/14/73) 3 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (9/ 5/73) 3 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (11/ 5/73) 3 SITES RANGE	MEAN	MEDIAN
TEMP (C)	25.3 - 26.9	26.1	25.9	28.3 - 29.5	28.9	28.9	21.3 - 23.4	22.4	22.5
DISS OXY (MG/L)	4.5 - 7.6	6.3	6.5	4.6 - 6.0	5.3	5.2	4.2 - 6.2	5.2	5.3
CNDCTVY (MCROMO)	1000. - 1090.	1021.	1000.	1080. - 1236.	1142.	1115.	682. - 716.	698.	700.
PH (STAND UNITS)	7.6 - 8.0	7.7	7.7	7.1 - 7.5	7.3	7.4	7.1 - 7.5	7.3	7.2
TOT ALK (MG/L)	40. - 44.	41.	41.	36. - 45.	41.	41.	33. - 45.	37.	36.
TOT P (MG/L)	0.183 - 0.367	0.229	0.198	0.179 - 0.324	0.214	0.188	0.099 - 0.234	0.153	0.153
ORTHO P (MG/L)	0.119 - 0.245	0.152	0.133	0.147 - 0.277	0.179	0.160	0.068 - 0.120	0.097	0.090
NO2+NO3 (MG/L)	0.040 - 0.100	0.061	0.050	0.110 - 0.180	0.146	0.150	0.140 - 0.220	0.167	0.150
AMMONIA (MG/L)	0.060 - 0.420	0.157	0.120	0.110 - 0.540	0.264	0.250	0.060 - 0.240	0.139	0.150
KJEL N (MG/L)	1.200 - 1.900	1.614	1.700	1.800 - 2.400	2.040	2.000	1.500 - 2.800	1.829	1.700
INORG N (MG/L)	0.110 - 0.520	0.219	0.150	0.220 - 0.720	0.410	0.390	0.210 - 0.390	0.306	0.300
TOTAL N (MG/L)	1.250 - 2.000	1.676	1.750	1.910 - 2.580	2.186	2.150	1.710 - 2.960	1.996	1.850
CHLRPYL A (UG/L)	19.4 - 19.7	19.5	19.5	10.8 - 31.3	18.8	14.2	3.6 - 7.7	6.1	7.
SECCHI (METERS)	0.6 - 0.8	0.7	0.8	0.4 - 0.8	0.7	0.8	0.4 - 0.7	0.5	0.5

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal units per ml
03/14/73	1. Lyngbya sp.	1,642
	2. Melosira sp.	1,318
	3. Microcystis sp.	1,219
	4. Nitzschia sp.	672
	5. Scenedesmus sp.	299
	Other genera	1,119
	Total	6,269
09/05/73	1. Melosira sp.	4,107
	2. Lyngbya sp.	3,850
	3. Cyclotella sp.	2,138
	4. Fragilaria sp.	2,053
	5. Flagellates	1,283
	Other genera	5,648
	Total	19,079
11/05/73	1. Chlamydomonas sp.	1,759
	2. Microcystis sp.	554
	3. Lyngbya sp.	434
	4. Centric diatoms	313
	5. Dactylococcopsis sp.	265
	Other genera	817
	Total	4,142

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
03/14/73	1	19.7
	2	-
	3	19.4
09/05/73	1	31.3
	2	14.2
	3	10.8
11/05/73	1	7.7
	2	7.1
	3	3.6

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.100	0.252	7.3
0.050 P	0.150	0.252	7.8
0.050 P + 1.0 N	0.150	1.252	30.3
1.0 N	0.100	1.252	28.5

2. Filtered and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.096	0.228	4.7
0.050 P	0.146	0.228	4.8
0.050 P + 1.0 N	0.146	1.228	23.6
1.0 N	0.096	1.228	36.0

3. Discussion -

The control yields of the assay alga, Selenastrum capricornutum, indicate that the potential primary productivity of Lake Monroe was high at the time the assay sample was collected (11/05/73). The addition of nitrogen alone or in combination with orthophosphorus significantly increased yields while addition of orthophosphorus alone did not. This indicates nitrogen limitation.

The lake data indicate nitrogen limitation at all sampling times; i.e., the mean inorganic nitrogen/orthophosphorus ratios were 4/1 or less at all sampling times and stations.

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Florida National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v). Sampling was begun in March, 1973, and was completed in February, 1974.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Florida District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads shown are those measured minus point-source loads, if any.

Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were summarized from Brezonik et al. (in prep.).

The operator of the Deltona wastewater treatment plant provided monthly effluent samples and corresponding flow data. The operator of the Sanford wastewater treatment plant did not participate in the Survey; nutrient loads from this source were estimated at 1.134 kg P and 3.401 N/capita/year, and flows were estimated at 0.3785 m^3/capita/day.

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* See Working Paper No. 175.

A. Waste Sources:

1. Known municipal -

Name	Pop. Served	Treatment	Mean Flow (m^3/d)	Receiving Water
Deltona*	9,000	act. sludge	1,612.6	Lake Monroe
Sanford**	22,600	act. sludge	8,554.1	Lake Monroe

2. Known industrial - None

* Treatment plant questionnaire.
** Anonymous, 1971.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
St. Johns River	480,250	91.4
Bethel Creek	375	0.1
b. Minor tributaries & immediate drainage (non-point load)* -	11,900	2.3
c. Known municipal STP's -		
Deltona	5,350	1.0
Sanford	25,630	4.9
d. Septic tanks** -	10	< 0.1
e. Known industrial - None	-	-
f. Direct precipitation*** -	1,560	0.3
Total	525,075	100.0

2. Outputs -

Lake outlet - St. Johns River 543,740

3. Net annual P loss - 18,665 kg.

* Brezonik et al., (in prep).
** Estimate based on 34 lakeshore dwellings; see Working Paper No. 175.
*** Brezonik and Shannon, 1971.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
St. Johns River	5,534,870	96.7
Bethel Creek	11,735	0.2
b. Minor tributaries & immediate drainage (non-point load)* -	72,700	1.3
c. Known municipal STP's -		
Deltona	6,670	0.1
Sanford	76,865	1.3
d. Septic tanks** -	360	< 0.1
e. Known industrial - None	-	-
f. Direct precipitation*** -	20,590	0.4
Totals	5,723,790	100.0

2. Outputs -

Lake outlet - St. Johns River 5,760,010

3. Net annual N loss - 36,230 kg.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
St. Johns River	75	865
Bethel Creek	24	757

* Brezonik et al., (in prep.)
** Estimate based on 34 lakeshore dwellings; see Working Paper No. 175.
*** Brezonik and Shannon, 1971.

E. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Note, however, that Florida lakes may be able to assimilate phosphorus at a somewhat higher level than that suggested by Vollenweider (Shannon and Brezonik, 1972).

Essentially, Vollenweider's "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	14.79	loss*	161.2	loss*

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Lake Monroe:

"Dangerous" (eutrophic loading)	1.54
"Permissible" (oligotrophic loading)	0.77

* There was an apparent loss of nutrients during the sampling year. This may have been due to nutrient fixation in the lake, solubilization of previously sedimented nutrients, unknown and unsampled point sources discharging directly to the lake, underestimation of the minor tributary and immediate drainage load, or (probably) insufficient sampling in relation to the short hydraulic retention time of the lake.

V. LITERATURE REVIEWED

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VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
1201	ALLIGATOR LAKE	0.620	0.260	474.000	87.733	13.100	0.386
1202	LAKE APOPKA	0.102	0.230	484.176	46.611	8.200	0.019
1203	LAKE BANANA	0.660	0.260	482.667	208.600	3.600	0.293
1206	LAKE CRESCENT	0.065	0.130	473.889	10.211	10.200	0.033
1207	DOCTORS LAKE	0.084	0.120	465.555	27.100	10.600	0.028
1208	LAKE DORA	0.102	0.240	482.889	59.978	7.400	0.022
1209	LAKE EFFIE	1.480	0.410	489.000	261.433	15.000	0.950
1210	LAKE GEORGE	0.129	0.165	469.308	35.000	11.000	0.063
1211	LAKE GIBSON	0.167	0.115	470.000	19.675	10.200	0.069
1212	GLENADA LAKE	0.134	0.165	454.167	27.667	14.700	0.072
1214	LAKE GRIFFIN	0.119	0.260	481.333	66.855	6.600	0.038
1215	LAKE HAINES	0.063	0.115	462.667	26.567	10.600	0.014
1217	LAKE HANCOCK	0.772	0.195	483.500	97.900	5.600	0.158
1219	LAKE HORSESHOE	0.034	0.130	459.000	12.067	11.500	0.023
1220	LAKE HOWELL	1.260	0.285	464.000	54.117	9.000	1.175
1221	LAKE ISTOKPOGA	0.039	0.120	464.222	6.594	8.600	0.010
1223	LAKE JESSUP	0.492	0.290	487.000	76.550	7.600	0.288
1224	LAKE KISSIMMEE	0.034	0.145	463.667	24.142	8.800	0.007
1227	LAKE LULU	1.490	1.065	483.000	276.566	14.300	1.030
1228	LAKE MARION	0.044	0.260	468.833	29.967	7.600	0.016
1229	LAKE MINNEHAHA	0.038	0.080	435.000	8.733	7.700	0.012
1230	LAKE MINNEOLA	0.018	0.070	406.333	3.333	7.400	0.009
1231	LAKE MONROE	0.188	0.300	474.555	14.225	10.800	0.128
1232	LAKE OKEECHOBEE	0.063	0.185	472.366	14.524	9.800	0.010
1234	LAKE POINSETT	0.085	0.150	469.000	6.500	10.600	0.051
1236	LAKE REEDY	0.033	0.330	468.500	34.837	10.600	0.008
1238	LAKE SOUTH	0.074	0.130	464.000	23.167	9.000	0.028
1239	LAKE TALQUIN	0.085	0.290	462.167	9.483	14.400	0.031

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
1240	LAKE THONOTOSASSA	0.695	0.095	466.167	37.700	10.200	0.565
1241	LAKE TOHOPEKALIGA	0.246	0.200	472.917	30.633	10.500	0.152
1242	TROUT LAKE	1.110	0.650	472.000	76.967	12.900	0.970
1243	LAKE WEOHYAKAPKA	0.047	0.080	458.667	7.767	8.200	0.011
1246	LAKE YALE	0.027	0.160	441.000	25.367	7.600	0.014
1247	LAKE MUNSON	1.475	0.925	486.667	140.317	12.200	0.852
1248	LAKE SEMINOLE	0.234	0.175	473.833	102.000	8.600	0.026
1249	LAKE LAWNE	2.560	1.350	494.667	84.900	10.400	0.117
1250	LAKE TARPON	0.041	0.070	400.889	6.867	9.000	0.027
1252	LAKE ELOISE	0.486	0.170	465.333	70.233	12.200	0.339
1258	LAKE JESSIE	0.051	0.090	452.667	26.300	10.800	0.011
1261	EAST LAKE TOHOPEKALIGA	0.042	0.070	440.833	5.167	9.400	0.007
1264	PAYNE'S PRAIRIE LAKE (NO	1.260	0.140	476.000	88.200	7.400	1.210

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
1201	ALLIGATOR LAKE	25 (10)	29 (10)	30 (12)	18 (7)	10 (4)	18 (7)	130
1202	LAKE APOPKA	50 (20)	38 (15)	10 (4)	38 (15)	74 (29)	70 (28)	280
1203	LAKE BANANA	23 (9)	29 (10)	20 (8)	5 (2)	100 (40)	23 (9)	200
1206	LAKE CRESCENT	65 (26)	70 (27)	33 (13)	80 (32)	48 (18)	50 (20)	346
1207	DOCTORS LAKE	60 (24)	76 (30)	60 (24)	55 (22)	34 (12)	56 (22)	341
1208	LAKE DORA	53 (21)	35 (14)	18 (7)	33 (13)	90 (35)	68 (27)	297
1209	LAKE EFFIE	5 (2)	10 (4)	3 (1)	3 (1)	0 (0)	10 (4)	31
1210	LAKE GEORGE	45 (18)	54 (21)	48 (19)	43 (17)	23 (9)	43 (17)	256
1211	LAKE GIBSON	40 (16)	81 (32)	45 (18)	70 (28)	48 (18)	40 (16)	324
1212	GLENADA LAKE	43 (17)	54 (21)	85 (34)	53 (21)	3 (1)	38 (15)	276
1214	LAKE GRIFFIN	48 (19)	29 (10)	23 (9)	30 (12)	95 (38)	48 (19)	273
1215	LAKE HAINES	70 (28)	81 (32)	75 (30)	58 (23)	34 (12)	78 (31)	396
1217	LAKE HANCOCK	18 (7)	43 (17)	13 (5)	13 (5)	98 (39)	28 (11)	213
1219	LAKE HORSESHOE	93 (37)	70 (27)	80 (32)	78 (31)	20 (8)	65 (26)	406
1220	LAKE HOWELL	11 (4)	23 (9)	69 (27)	35 (14)	60 (23)	3 (1)	201
1221	LAKE ISTOKPOGA	85 (34)	76 (30)	65 (26)	93 (37)	69 (27)	89 (35)	477
1223	LAKE JESSUP	28 (11)	18 (7)	5 (2)	25 (10)	83 (32)	25 (10)	184
1224	LAKE KISSIMMEE	90 (36)	63 (25)	73 (29)	65 (26)	65 (26)	99 (39)	455
1227	LAKE LULU	3 (1)	3 (1)	15 (6)	0 (0)	8 (3)	5 (2)	34
1228	LAKE MARION	78 (31)	29 (10)	53 (21)	50 (20)	83 (32)	73 (29)	366
1229	LAKE MINNEHAHA	88 (35)	91 (36)	95 (38)	85 (34)	78 (31)	80 (32)	517
1230	LAKE MINNEOLA	100 (40)	98 (38)	98 (39)	100 (40)	90 (35)	93 (37)	579
1231	LAKE MONROE	38 (15)	15 (6)	28 (11)	75 (30)	26 (10)	33 (13)	215
1232	LAKE OKEECHOBEE	68 (27)	45 (18)	40 (16)	73 (29)	53 (21)	89 (35)	368
1234	LAKE POINSETT	58 (23)	60 (24)	50 (20)	95 (38)	34 (12)	45 (18)	342
1236	LAKE REEDY	95 (38)	13 (5)	55 (22)	45 (18)	34 (12)	95 (38)	337
1238	LAKE SOUTH	63 (25)	70 (27)	69 (27)	68 (27)	60 (23)	56 (22)	386
1239	LAKE TALQUIN	55 (22)	20 (8)	78 (31)	83 (33)	5 (2)	53 (21)	294

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
1240	LAKE THONOTOSASSA	20 (8)	85 (34)	58 (23)	40 (16)	48 (18)	15 (6)	266
1241	LAKE TOHOPEKALIGA	33 (13)	40 (16)	38 (15)	48 (19)	40 (16)	30 (12)	229
1242	TROUT LAKE	15 (6)	8 (3)	43 (17)	23 (9)	13 (5)	8 (3)	110
1243	LAKE WEOHYAKAPKA	75 (30)	91 (36)	83 (33)	88 (35)	74 (29)	84 (33)	495
1246	LAKE YALE	98 (39)	58 (23)	90 (36)	63 (25)	83 (32)	75 (30)	467
1247	LAKE HUNSON	8 (3)	5 (2)	8 (3)	8 (3)	16 (6)	13 (5)	58
1248	LAKE SEMINOLE	35 (14)	48 (19)	35 (14)	10 (4)	69 (27)	63 (25)	260
1249	LAKE LAWNE	0 (0)	0 (0)	0 (0)	20 (8)	43 (17)	35 (14)	98
1250	LAKE TARPON	83 (33)	98 (38)	100 (40)	90 (36)	60 (23)	60 (24)	491
1252	LAKE ELOISE	30 (12)	50 (20)	63 (25)	28 (11)	16 (6)	20 (8)	207
1258	LAKE JESSIE	73 (29)	88 (35)	88 (35)	60 (24)	26 (10)	84 (33)	419
1261	EAST LAKE TOHOPEKALIGA	80 (32)	98 (38)	93 (37)	98 (39)	55 (22)	99 (39)	523
1264	PAYNE'S PRAIRIE LAKE (NO	11 (4)	65 (26)	25 (10)	15 (6)	90 (35)	0 (0)	206

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	1230	LAKE MINNEOLA	579
2	1261	EAST LAKE TOHOPEKALIGA	523
3	1229	LAKE MINNEHAHA	517
4	1243	LAKE WEOHYAKAPKA	495
5	1250	LAKE TARPON	491
6	1221	LAKE ISTOKPOGA	477
7	1246	LAKE YALE	467
8	1224	LAKE KISSIMMEE	455
9	1258	LAKE JESSIE	419
10	1219	LAKE HORSESHOE	406
11	1215	LAKE HAINES	396
12	1238	LAKE SOUTH	386
13	1232	LAKE OKEECHOBEE	368
14	1228	LAKE MARION	366
15	1206	LAKE CRESCENT	346
16	1234	LAKE POINSETT	342
17	1207	DOCTORS LAKE	341
18	1236	LAKE REEDY	337
19	1211	LAKE GIBSON	324
20	1208	LAKE DORA	297
21	1239	LAKE TALQUIN	294
22	1202	LAKE APOPKA	280
23	1212	GLENADA LAKE	276
24	1214	LAKE GRIFFIN	273
25	1240	LAKE THONOTOSASSA	266
26	1248	LAKE SEMINOLE	260
27	1210	LAKE GEORGE	256
28	1241	LAKE TOHOPEKALIGA	229

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
29	1231	LAKE MONROE	215
30	1217	LAKE HANCOCK	213
31	1252	LAKE ELOISE	207
32	1264	PAYNE'S PRAIRIE LAKE (NO	206
33	1220	LAKE HOWELL	201
34	1203	LAKE BANANA	200
35	1223	LAKE JESSUP	184
36	1201	ALLIGATOR LAKE	130
37	1242	TROUT LAKE	110
38	1249	LAKE LAWNE	98
39	1247	LAKE MUNSON	58
40	1227	LAKE LULU	34
41	1209	LAKE EFFIE	31

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles.

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 - cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR FLORIDA 8/25/75

LAKE CODE 1231 LAKE MONROE

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 6682.2

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1231A1	6682.2	46.27	40.15	67.22	46.81	14.47	34.01	85.69	91.24	145.58	162.03	94.32	61.59	74.33
1231A2	6397.3	44.49	39.87	63.09	43.07	15.46	34.35	81.07	88.60	141.30	153.87	88.66	57.28	71.12
123181	15.5	0.11	0.11	0.20	0.08	0.03	0.14	0.31	0.34	0.51	0.37	0.11	0.08	0.20
1231ZZ	233.1	1.56	1.67	2.86	1.39	0.62	2.15	4.56	4.93	7.73	5.49	1.73	1.16	3.00

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 6682.2
SUM OF SUB-DRAINAGE AREAS = 6645.9
TOTAL FLOW IN = 889.37
TOTAL FLOW OUT = 889.37

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
1231A1	3	73	53.66	18	34.29				
	4	73	46.55	8	50.60				
	5	73	25.63	13	9.97				
	6	73	11.81	3	-5.10	25	-3.51		
	7	73	35.23	7	48.45				
	8	73	67.90	20	79.17				
	9	73	111.85	9	155.29				
	10	73	120.86	15	110.29				
	11	73	95.26	4	119.87				
	12	73	60.54	9	25.32				
	1	74	36.93	6	38.03				
	2	74	10.62	2	19.99				
1231A2	3	73	48.42	18	33.58				
	4	73	43.13	8	46.72				
	5	73	24.83	13	14.89				
	6	73	13.88	3	2.29	25	5.32		
	7	73	34.66	7	41.43				
	8	73	65.78	20	75.15				
	9	73	107.49	9	144.27				
	10	73	118.25	15	107.77				
	11	73	89.54	4	110.44				
	12	73	55.93	9	33.75				
	1	74	34.38	6	36.33				
	2	74	11.78	2	19.31				

TRIBUTARY FLOW INFORMATION FOR FLORIDA

LAKE CODE 1231 LAKE MONROE 8/25/75

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
123181	3	73	0.09	18	0.07				
	4	73	0.08	8	0.11				
	5	73	0.03	13	0.03				
	6	73	0.04	3	0.04	25	0.06		
	7	73	0.12	7	0.08				
	8	73	0.34	21	0.15				
	9	73	0.34	9	0.54				
	10	73	0.24	15	0.16				
	11	73	0.07	4	0.09				
	12	73	0.06	9	0.06				
	1	74	0.05	6	0.07				
	2	74	0.04	2	0.04				
1231ZZ	3	73	1.33	18	1.02				
	4	73	1.27	8	1.76				
	5	73	0.57	13	0.57				
	6	73	0.65	3	0.59	25	0.85		
	7	73	1.73	7	1.19				
	8	73	4.84	21	2.15				
	9	73	5.27	9	8.13				
	10	73	3.51	15	2.35				
	11	73	0.99	4	1.36				
	12	73	0.82	9	0.76				
	1	74	0.74	6	0.91				
	2	74	0.57	2	0.54				

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/08/25

123101
28 50 02.0 081 18 56.0
LAKE MONROE
12127 FLORIDA

11EPALES
3

2111202
0013 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/03/14	15	0000	26.8		32	1090	7.60	41	0.120	1.800	0.040	0.143
	15	0004	26.9	7.6		1000	8.00	40	0.060	1.200	0.050	0.133
	15	0009	26.4	7.1		1000	7.90	40	0.090	1.300	0.050	0.128
73/09/05	12	0000	29.5		31	1193	7.50	36	0.160	2.000	0.160	0.160
	12	0005	28.8	6.0		1236	7.20	41	0.110	1.800	0.110	0.147
73/11/05	10	0000	23.4		29	716	7.20	45	0.080	1.700	0.220	0.090,
	10	0005	23.2	6.2		712	7.20	39	0.070	1.500	0.210	0.068

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/03/14	15	0000	0.197	19.7
	15	0004	0.190	
	15	0009	0.198	
73/09/05	12	0000	0.196	31.3
	12	0005	0.183	
73/11/05	10	0000	0.124	7.7
	10	0005	0.099	

STORET RETRIEVAL DATE 75/08/25

123102
28 51 20.0 081 16 24.0
LAKE MONROE
12127 FLORIDA

11EPALES
3

2111202
0010 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/03/14	15 50	0000	25.9		32	1000	7.70	41	0.100	1.700	0.050	0.119
	15 50	0006	25.5	6.0		1000	7.70	41	0.120	1.500	0.070	0.122
73/09/05	12 25	0000	29.2		32	1115	7.50	41	0.250	2.000	0.150	0.160
	12 25	0005	28.3	5.2		1080	7.10	41	0.260	2.000	0.130	0.150
73/11/05	11 00	0000	22.9		18	700	7.20	36	0.060	1.700	0.150	0.084
	11 00	0006	22.5	5.0		704	7.10	35	0.150	2.800	0.160	0.089

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/03/14	15 50	0000	0.183	
	15 50	0006	0.198	
73/09/05	12 25	0000	0.188	14.2
	12 25	0005	0.179	
73/11/05	11 00	0000	0.116	7.1
	11 00	0006	0.234	

STORET RETRIEVAL DATE 75/08/25

123103
28 48 59.0 081 16 15.0
LAKE MONROE
12117 FLORIDA

11EPALES
3

2111202
0010 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/03/14	16 30	0000	25.6		24	1010	7.70	41	0.190	1.900	0.070	0.177
	16 30	0006	25.3	4.5		1050	7.60	44	0.420	1.900	0.100	0.245
73/09/05	11 15	0000	28.9	4.6	16	1086	7.40	45	0.540	2.400	0.180	0.277
73/11/05	11 10	0000	22.3		15	689	7.40	36	0.160	1.800	0.140	0.120
	11 10	0005	21.3	4.2		682	7.30	33	0.210	1.700	0.140	0.118
	11 10	0011	21.3	5.6		683	7.50	33	0.240	1.600	0.150	0.113

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/03/14	16 30	0000	0.272	19.4
	16 30	0006	0.367	
73/09/05	11 15	0000	0.324	10.8
73/11/05	11 10	0000	0.172	3.6
	11 10	0005	0.170	
	11 10	0011	0.153	

APPENDIX E

TRIBUTARY AND WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 75/08/25

1231A1
28 50 30.0 081 19 30.0
ST JOHNS RIVER
12069 7.5 SANFORD
O/LAKE MONROE
ST HWY 600 BRDG .5 MI S OF VALDEZ
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/03/18	10 30		0.062	1.400	0.100	0.16K	0.240
73/04/08	09 50		0.010K	1.600	0.046	0.147	0.220
73/05/13	10 40		0.010K	1.400	0.024	0.160	0.240
73/06/03	11 00		0.022	7.400	1.300	0.154	0.360
73/06/25	12 15		0.010K	5.800	0.130	0.210	0.320
73/07/07	11 10		0.012	1.600	0.050	0.210	0.320
73/08/20	11 00		0.010K	1.800	0.036	0.160	0.280
73/09/09	11 10		0.380	0.990	0.098	0.210	0.210
73/10/15	11 15		0.154	1.450	0.105	0.138	0.170
73/11/04	11 30		0.200	1.100	0.048	0.092	0.110
73/12/09	11 10		0.176	2.200	0.088	0.104	0.125
74/01/06	11 05		0.016	1.300	0.036	0.096	0.160
74/02/02	11 53		0.176	2.200	0.055	0.170	0.220

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/08/25

1231A2
28 48 00.0 081 12 30.0
ST JOHNS RIVER
12 7.5 OSTEEN
I/LAKE MONROE
ST HWY 415 BRDG IN INDIN MOUND VILLAGE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/03/18	09	10	0.138	1.700	0.126	0.126	0.170
73/04/08	09	04	0.154	1.540	0.060	0.150	0.200
73/05/13	09	55	0.060	5.000	0.225	0.139	0.180
73/06/03	10	15	0.027	4.600	0.230	0.189	0.230
73/06/25	11	00	0.044	1.300	0.160	0.200	0.250
73/07/07	10	10	0.014	4.000	0.130	0.220	0.300
73/08/20	09	35	0.058	2.200	0.081	0.180	0.240
73/09/09	10	30	0.230	1.300	0.078	0.126	0.155
73/10/15	12	37	0.077	1.500	0.064	0.094	0.130
73/11/04	10	10	0.088	1.400	0.052	0.100	0.115
74/01/06	10	15	0.240	2.100	0.120	0.176	0.220
74/02/02	11	23	0.112	1.300	0.035	0.280	0.345

STORET RETRIEVAL DATE 75/08/25

123181
28 51 00.0 081 13 30.0
BETHEL CREEK
12 7.5 OSTEEN
T/LAKE MONROE
BRDG .75 MI W OF LAKE BETHEL
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/03/18	09	55	0.036	0.600	0.040	0.037	0.045
73/04/08	09	21	0.021	0.685	0.046	0.034	0.045
73/05/13	10	15	0.026	0.920	0.100	0.030	0.045
73/06/03	10	45	0.034	4.950	0.280	0.029	0.040
73/06/25	11	30	0.010K	3.200	0.078	0.033	0.035
73/07/07	10	35	0.027	3.080	0.338	0.037	0.050
73/08/21	14	30	0.046	0.600	0.046	0.029	0.045
73/09/09	10	45	0.013	1.680	0.075	0.078	0.170
73/10/15	12	55	0.012	1.750	0.056	0.060	0.120
73/11/04	11	00	0.012	1.450	0.054	0.012	0.015
73/12/09	10	45	0.016	1.700	0.068	0.040	0.045
74/01/06	10	35	0.056	0.700	0.084	0.040	0.055
74/02/02	11	40	0.064	1.850	0.100	0.045	0.045

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/08/25

12310A A512310A P009800
28 47 30.0 081 15 00.0
DELTONA
12069 7.5 OSTEEN
T/LAKE MONROE
ST JOHNS RIVER
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/09/19	11 30		6.000	4.800	0.010	7.740	8.200	0.378	0.401
73/10/24	11 30		6.600	4.900	0.170	9.100	9.200	0.446	0.436
73/11/16	10 00		3.500	5.600	0.048	8.900	8.900	0.399	0.410
73/12/20	09 45		7.000	5.100	0.480	7.900	7.900	0.375	0.395
74/01/21	11 00		3.120	6.000	0.980	7.850	8.200	0.426	0.408
74/02/20	11 00		6.720	9.200	0.980	7.800	8.700	0.416	0.450
74/03/19	13 45		2.000	12.000	1.200	8.200	9.000	0.500	0.413
74/04/22	11 00		2.080	7.700	0.920	12.000	13.000	0.422	0.430
74/05/20	09 30		7.920	6.350	0.050K	9.200	9.550	0.444	0.446
74/06/19	09 00		3.360	7.400	0.092	6.200	6.900	0.420	0.429
74/07/22	13 00		3.840	7.500	0.180	8.300	9.500	0.442	0.434
74/08/19	10 00		0.040	6.700	0.050K	0.120	9.700	0.440	0.460

K VALUE KNOWN TO BE
LESS THAN INDICATED